What is claimed is:

1. In a charged-particle-beam (CPB) microlithography method in which a pattern is defined on a segmented reticle that is divided into multiple exposure units each defining a respective portion of the pattern that is transferred by a charged particle beam to a respective location in a die on a sensitive substrate, an improvement comprising:

arranging the exposure units on the reticle in a grid array extending in X and Y directions, the grid array including minor stripes each extending in the X direction and being arranged in the Y direction, each minor stripe comprising at least one exposure unit;

successively deflecting a charged-particle illumination beam in the X direction to illuminate each exposure unit in each minor stripe and to illuminate the minor stripes in an ordered manner; and

in a region on the reticle including one or more minor stripes, illuminating the one or more minor stripes multiple times such that the respective exposure units are illuminated multiple times by the illumination beam and transferred to the respective locations in the die on the substrate.

2. The method of claim 1, wherein:

the exposure units are respective subfields; and

each minor stripe comprises multiple respective subfields.

3. The method of claim 1, wherein each minor stripe in the region is illuminated each of n times by the illumination beam at an illumination-dose that is 1/n times the illumination-dose that otherwise would be received by the minor stripe if the minor stripe were illuminated only once.

4. The method of claim 1, wherein:

the reticle includes multiple regions that are individually transferred to the die;

each region includes multiple respective minor stripes; and

the minor stripes in each region are illuminated multiple times to complete transfer of the region to the die before illumination progresses to the next region.

5. The method of claim 4, wherein the regions are transferred sequentially to the die.

6. The method of claim 1, wherein:

the exposure units are respective subfields;

the reticle includes multiple major stripes that are individually transferred to the die;

each major stripe comprises multiple regions each comprising multiple respective minor stripes, the regions being individually transferred to the die;

each minor stripe comprises multiple respective subfields; and

the minor stripes in each region are illuminated multiple times to complete transfer of the region to the die before illumination progresses to the next region.

7. The method of claim 5, wherein, during exposure of each region, the respective constituent minor stripes are illuminated according to a predetermined order before repeating exposure of the minor stripes of the region.

8. The method of claim 1, wherein:

the exposure units are respective subfields;

the reticle comprises multiple minor stripes grouped into multiple regions that are transferred individually to the die;

each region comprises multiple respective minor stripes each comprising multiple respective subfields; and

the minor stripes in each region are illuminated multiple times to complete transfer of the region to the die before illumination progresses to the next region.

9. The method of claim 7, wherein, during exposure of each region, all the constituent minor stripes are illuminated according to a predetermined order before repeating exposure of the minor stripes of the region.

10. The method of claim 1, wherein:

each region comprises multiple respective minor stripes, and each minor stripe comprises multiple respective exposure units; and

during exposure of each region the illumination beam is deflected in the X direction to illuminate each respective exposure unit in a minor stripe and in the Y direction to progress from one minor stripe to another in the region.

11. The method of claim 10, wherein during exposure of the pattern, progression from one region on the reticle to the next is achieved by moving the reticle in the Y direction.

12. A method for performing charged-particle-beam microlithography of a pattern to a die on a sensitive substrate, the method comprising:

dividing the pattern as defined on the reticle into multiple major stripes of respective subfields arrayed in an X-Y grid on the reticle, each major stripe comprising multiple respective minor stripes each extending across a width of the

respective major stripe, at least one major stripe comprising a respective group of constituent minor stripes that are exposed more than once in the die;

using a charged-particle illumination beam and a corresponding charged-particle patterned beam, transferring the major stripes, the minor stripes within each major stripe, and the subfields within each minor stripe in an ordered manner; and

transferring each of the minor stripes in the group in an ordered manner multiple times to respective minor stripes on the die.

13. The method of claim 12, wherein each minor stripe in the group is transferred each of n times at an exposure dose that is 1/n times the exposure dose that otherwise would be received by the minor stripe if the minor stripe were illuminated only once.

14. The method of claim 12, wherein:

each major stripe includes multiple respective groups that are individually transferred to the die;

each group includes multiple respective minor stripes; and

the minor stripes in each group are transferred multiple times to complete transfer of the group to the die before illumination progresses to the next group.

15. The method of claim 14, wherein, during exposure of each group, the respective constituent minor stripes are transferred according to a predetermined order before repeating exposure of the minor stripes of the group.

16. The method of claim 12, wherein:

during transfer of each constituent subfield of a minor stripe, the subfield is illuminated by an illumination beam that is deflected in the X direction to illuminate in a sequential manner all the subfields of the minor stripe; and

progression from one group on the reticle to the next is achieved by moving the reticle in the Y direction.

17. A charged-particle-beam (CPB) microlithography apparatus for transferring a pattern, defined on a segmented reticle divided into multiple exposure units each defining a respective portion of the pattern, to a substrate, the exposure units being grouped into at least one major stripe comprising multiple minor stripes of respective exposure units, the minor stripes extending in an X direction and being arrayed in the major stripe in the Y direction, the apparatus comprising along a Z direction:

an illumination-optical system configured to direct an illumination beam from a source to the reticle;

a reticle stage situated downstream of the illumination-optical system and configured to hold the reticle;

a projection-optical system situated downstream of the reticle stage and configured to direct a patterned beam from the reticle to the substrate;

a wafer stage situated downstream of the projection-optical system and configured to hold the substrate during exposure of the substrate; and

a main controller connected to the illumination-optical system, the reticle stage, the projection-optical system, and the wafer stage, the main controller being configured to (i) control transfer of the pattern from the reticle to a substrate mounted to the wafer stage, (ii) successively deflect the illumination beam in an X direction to illuminate each exposure unit in each minor stripe and to illuminate the minor stripes in an ordered manner, (iii) in a region on the reticle including one or more minor stripes, illuminate the minor stripes multiple times such that the

respective exposure units are transferred multiple times to respective locations in the die on the substrate.

18. A charged-particle-beam (CPB) microlithography apparatus for transferring a pattern, defined on a segmented reticle divided into multiple subfields each defining a respective portion of the pattern, to a substrate, the subfields being grouped into multiple major stripes each comprising multiple respective minor stripes each comprising multiple respective subfields, wherein at least one major stripe comprises a respective group of constituent minor stripes that are exposed more than once in the die, and the minor stripes extend in an X direction and are arrayed in each major stripe in the Y direction, the apparatus comprising along a Z direction:

an illumination-optical system configured to direct an illumination beam from a source to the reticle;

a reticle stage situated downstream of the illumination-optical system and configured to hold the reticle;

a projection-optical system situated downstream of the reticle stage and configured to direct a patterned beam from the reticle to the substrate;

a wafer stage situated downstream of the projection-optical system and configured to hold the substrate during exposure of the substrate; and

a main controller connected to the illumination-optical system, the reticle stage, the projection-optical system, and the wafer stage, the main controller being configured to (i) control transfer of the pattern from the reticle to a substrate mounted to the wafer stage, during which transfer the major stripes, the minor stripes within each major stripe, and the subfields within each minor stripe are transferred in an ordered manner using the illumination beam and the patterned beam, and (ii) control transfer of each of the minor stripes in the group in an ordered manner multiple times to respective minor stripes on the die.

19. A method for manufacturing a microelectronic device, comprising:

(a) preparing a wafer;

(b) processing the wafer; and

(c) assembling devices formed on the wafer during steps (a) and (b), wherein step (b) comprises the steps of (i) applying a resist to the wafer; (ii) exposing the resist; and (iii) developing the resist; and step (ii) is performed using a CPB microlithography apparatus as recited in claim 17.

20. A method for manufacturing a microelectronic device, comprising:

(a) preparing a wafer;

(b) processing the wafer; and

(c) assembling devices formed on the wafer during steps (a) and (b), wherein step (b) comprises the steps of (i) applying a resist to the wafer; (ii) exposing the resist; and (iii) developing the resist; and step (ii) is performed using a CPB microlithography apparatus as recited in claim 18.

21. A microelectronic device produced using the method of claim 19.

22. A microelectronic device produced using the method of claim 20.